Echo Lake Environmental Education Day

Travels of Our Trash

Ms. Bowhay’s 6th Grade Class

Becca Cohn, Kenzie Gauthier, Elsa Klein

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**Introduction**

Title: Travels of our Trash

SU Teachers: Becca Cohn, Kenzie Gauthier, Elsa Klein

Class:  Ms. Bowhay, 6th Grade, Room 25

Importance of Featured Concepts:

Our environmental education day is centered on the challenges of managing our waste as well as the solutions that we can enact to more responsibly dispose of our waste.  We will be exploring our waste streams, including the long journey trash takes to the landfill and the pervasive issue of ocean trash.  Ms. Bowhay’s 6th grade class participated in the fall SU environmental education day focused on recycling, and so these lessons on waste are intended to raise students’ awareness of what happens to the items that do not get recycled and in so doing reinforce the importance of recycling.  Ms. Bowhay is also starting a science unit on hazardous waste, so our lessons are well positioned to precede her unit and give students background knowledge on how landfills are designed to handle waste, and why some hazardous substances cannot be safely contained by landfill technology.

The morning activities are designed to awaken students to the sheer volume of trash that is being created by themselves and their community, and then teach students where this waste goes, whether it be landfills or oceans.  The afternoon lessons have students create solutions to waste management issues.  They will design a landfill that prevents groundwater contamination and create an action project to either raise awareness about trash’s impact on our environment or design a new waste management technique.  These lessons are designed to meet the needs of middle school aged students as there are opportunities for self-definition and project choice, activities that involve a lot of movement, and use compelling and novel content (Wormeli, 2006).  In particular, Ms. Bowhay told us that her students need collaborative activities that get them up moving around the classroom and that engage them in the content.  Furthermore, adolescents enjoy working collaboratively for a purpose, especially one that can have positive local or global impacts (J. Anderson, personal communication, September 23, 2015), so the day is rounded out with a Taking Action Project to give them the opportunity to use their learning to make positive change.

Learning Targets:

Concept Learning Target: Students will understand the impact that waste has on the environment.

Disposition Learning Target: Students will appreciate the environmental benefits of waste reduction.

Skill Learning Target: Students will work cooperatively with their peers.

Alignment with Next Generation Science Standards:

MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

MS-ESS3-4. Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.

MS-LS2-3. Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.

**Schedule**

9:00-9:15 am        Morning Work: Math worksheet (Kenzie)

9:15-10:00 am      Journey of a candy wrapper (Becca)

10:00-10:45 am    *Library*

10:45-11:00 am    TED-Ed video and Read Aloud (Elsa)

11:00-11:15 am    *Recess*

11:15-11:45 am    Great Pacific Garbage Patch- build a simulated water column (Elsa)

11:45am -12:30 pm    Great Pacific Garbage Patch- plastics & wildlife activity (Elsa)

12:30-12:45 pm    Introduce landfill project (Kenzie)

12:45-1:30 pm        *Lunch and Recess*

1:30-2:30 pm        Build a landfill project (Kenzie)

2:30-3:20 pm        Taking Action Project (Becca)

**Individual Lesson Plans**

**Morning Math Work**

Learning Target

Students will understand how much trash is created in one year in Shoreline.

Invitation

As students come into the classroom that morning, we will introduce ourselves and explain with Ms. Bowhay that we are leading them in Environmental Education Day. This class got to experience Environmental Education Day in the fall on the topic of recycling, so they will be familiar with the day and topic. We will have a guide sheet on each desk with name tags for the students to write their name and use throughout the day so that we know what to call them by.

Exploration

Students typically spend the morning doing math work at their desks, so we have decided to follow this model by having students estimate how much garbage they produce. This will give them a foundation for our topic of the day while making it personal to their lives.

Explanation

After students estimate how much trash they create in one day, we will have them to use that estimation and calculate how much trash they create in one year. We will then tell students that there are 54,790 people who live in Shoreline. Students will then use their answer from question #2 (rounded to the nearest whole number) to calculate how many pounds of trash are created by the residents of Shoreline in one year. We will then compare these calculations to the calculations of wasted created by the average American: 4.3 lbs/day, 1,569.5lbs/year, 85,992,905 lbs/year in Shoreline. We will then show pictures of these weights as compared with standard things like a small dog, an elephant and a cruise ship. Students will see how accurate their estimations were and then we will lead into the next activity which teaches students the journey of trash after it has been put in the garbage can.

Special Needs

For the two students who are English language learners in this class, we will provide vocabulary banks along with the math guide sheets. We will teach this vocabulary during the introduction and check in with students as well to ensure their understanding.

Technology

We will use the document camera and PowerPoint slides to introduce the day and to teach academic vocabulary.

**Journey of a Candy Wrapper**

Learning Target

Students will understand where their trash goes once it leaves the classroom by simulating the journey of a candy wrapper.

Timing

15 minute intro and brainstorm, 20 minute outdoor activity, 10 minute debriefing discussion.

Invitation

Upon completing their morning activity, students will be instructed to look at the front of the room where Becca will be finishing a Hershey’s chocolate bar. After finishing the candy bar, Becca will throw the wrapper into the garbage can and ask students where the wrapper will go next. Students will discuss the journey of trash in a whole-group discussion, while we write their brainstorm ideas on the board.

Exploration

Once students are finished brainstorming, we will tell students that when we throw away our trash, it doesn’t just disappear. Rather, each piece of trash goes on a journey before ending up in its final destination. Students will then be given a map of western Washington that shows Echo Lake Elementary School, the Shoreline Recycling & Transfer Station, and Cedar Hills Regional Landfill. Students will learn that once they throw something in the trash at school it goes to the school dumpster, then to the Shoreline Recycling & Transfer Station, and then to the Cedar Hills Regional Landfill in Maple Valley. Students will learn that one piece of trash that they throw away in their classroom goes on a ~36 mile journey to get to its final destination.

Next, students will bring this journey to life by recreating the cycle on the playground, which will ultimately solidify their understanding. Students will draw popsicle sticks to figure out the role that they are going to assume in the cycle. Various roles will include: candy wrapper, janitor, school dumpster, garbage truck driver, garbage truck, Shoreline Recycling & Transfer Station, transfer station employee, waste truck, waste truck driver, and Cedar Hills Regional Landfill. Students will decide where they stand on the playground based on their own estimations and the map they were given in class. Once students are set-up, they will simulate the journey that the candy wrapper takes to the landfill. Through this activity students will actively gain perspective on the many steps involved in our waste management streams.

Explanation

After students have completed the simulation on the playground, they will return to the classroom for a follow-up activity and debriefing. Students will view pictures of a landfill, watch a timelapse video from Cedar Hills Regional Landfill, and see a map that shows how far the trash will travel. Students will then see pictures of countries that do not have proper waste management systems set in place. Students will then be prompted to come up with some pros and cons of this waste system in their table groups.

Assessment

Students will discuss pros and cons of the waste system that they have in Shoreline. Students will discuss this in their table groups for 2-4 minutes before participating in a whole-class discussion. During the whole-class discussion, we will write the pros and cons on the board. After each table group contributes to the whole-class discussion, we will pose the question, “What happens if someone throws a plastic water bottle into the garbage can? How does that change your list of pros and cons for the waste system?” Students will then share their answer out to the whole group. Ultimately, students will show understanding of the learning target by incorporating the various steps in the journey of trash into their discussion.

Special Needs

For our ELL students, we have provided visuals to assist in understanding the concepts we are discussing. In addition, we are making sure that the information presented orally, both by teachers and students, is also written on the board.

We have decided to incorporate movement into this activity in order to increase student engagement and interest. We also realize that students spend the majority of their time during the day at their desks, so we thought this would be a perfect opportunity for students to learn the content while moving around and being outside.

Technology:

During this lesson, we have incorporated technology by using PowerPoint slides to show pictures of landfills, a map of the waste stream, and a video of a landfill.

**TED-Ed and Read Aloud**

In the 15 minute timeframe we have between their library class and recess, we will show students a TED-Ed video about the journeys of three plastic water bottles, one that is recycled, one that goes to the landfill and one that floats out to the Great Pacific Garbage Patch. <http://ed.ted.com/lessons/what-really-happens-to-the-plastic-you-throw-away-emma-bryce>. This will reinforce students’ learning in the morning about trash’s journey to the landfill, and preview the Great Pacific Garbage Patch lesson.  We will preview challenging vocabulary in the video and re-watch sections of the video if needed to reinforce vocabulary and content.  We will then read passages from *Not your Typical Book about the Environment*, by Elin Kelsey, which is a book written to show young readers innovation solving our environmental problems, which will give students inspiration to improve our waste management systems in the afternoon lessons.

**Great Pacific Garbage Patch**

Learning Targets

Students will understand that the Great Pacific Garbage Patch has grave impacts to a wide variety of wildlife species feeding at all levels of the ocean.

Timing

30 minutes building a simulated water column, 30 minutes wildlife and plastics activity, 15 minutes food chain and concluding discussions

Invitation

A large clear bucket of water will be sitting at the front of the room when the students return from recess.  On the table next to the bucket will be various forms of ocean trash including plastic bags, rope, CDs, small toys, six-pack holders, and plastic water bottles.  We will tell students that scientists estimate that between 15% and 40% of the plastic we throw out each year worldwide ends up in our oceans.  This startling fact combined with the curiosity and anticipation of how the items on the table will be used, will serve as the anticipatory set for the lesson.

Exploration

We will explain that this bucket is a water column in the middle of the Pacific Ocean, and share the definition of a water column.  One-by-one each trash item will be passed around the room and students will be asked to form a prediction on whether each object will float on the surface, stay in the middle of our water column (pelagic zone), or sink to the bottom (benthic zone), and must justify their prediction.  After each student has made a prediction, the item will be dropped into our water column. We will be shaking the bucket and stirring it with a spoon periodically to simulate currents and waves. This process will be repeated with all items.  The last item will be glitter which we will tell the students is meant to simulate all of the tiny broken-down pieces of plastic, or microplastics.  We will tell students that we have just created our own classroom model of the Pacific Garbage Patch.

Explanation

We will then explain that the Pacific Garbage Patch is not a floating island of trash, but a plastic soup of varying sizes of plastic particles at all levels of the ocean, just like our classroom water column represents.  Next we’ll show the following video which will introduce students to the Great Pacific Garbage Patch: <https://www.youtube.com/watch?v=mpsm-SqNYjs>. After showing the movie we will have students ask questions, and show additional images of the Pacific Garbage Patch from the books, *Tracking Trash* by Loree Griffin Burns, and *Plastic Ahoy* by Patricia Newman.

We will then hand out cards with information about several marine organisms, including the ocean level at which they feed.  These animals range from sea otters who are bottom feeders, to orca whales who feed in the pelagic zone, to elegant terns who feed on the surface.  Each student will have a deck of cards with all ten of the marine animals, and a chart representing the ocean water column.  They will have to draw in the various forms of plastic that could be present at each level, and then must tape the animal cards at the appropriate level.

As an extension, we will then as a class use the wildlife cards to build one or two possible food chains on the board.  We will also add a human card, and factor in our consumption of fish into the food web.  This activity will help students visualize how toxins in plastics can travel up through the food web to affect many different wildlife species and ourselves.

Assessment

The ocean water column/ocean animal feeding zone association project will serve as the assessment for this lesson.  Students will demonstrate their understanding of the “plastic soup” in the Pacific Garbage Patch, and how it impacts a wide variety of birds, fish and mammals.

Special Needs

For the two ELL students in the class, we will ensure that directions are repeated and that clarification on content is provided on a one-on-one basis.  Books will be shared on the document camera so that these students can associate words with photos and illustrations of the garbage patch.

Technology

We will be showing a YouTube video of the Pacific Garbage Patch, and then use the document camera to show images and read-aloud segments of text.

**Landfill Project**

Learning Targets

Students will describe a landfill’s function and purpose.

Students can describe how landfills can be hazardous for the environment if they are not well engineered.

Timing

15 minute introduction to project and directions, 45 minutes design build landfills, 15 minutes presentations and discussion

Invitation

Students will return from lunch and recess to the classroom and be invited to the carpet to see what they will be exploring next. Students will view a short video that shows what landfills look like in real life and describes how our waste gets there. We will then walk through a quick PowerPoint presentation that prompts students in a discussion about what our world does with garbage, where it goes, and how it should be processed.

Exploration

Students will work in 6 groups of 4 at their table groups to create their own landfill using provided materials. They will have assigned roles that contribute to the project in unique ways. The roles are: Project engineer, design engineer, construction engineer, and budget office. Each group must design a landfill that 1) can hold the most garbage, 2) minimizes the cost, while making sure that, 3) the landfill is able to contain the waste during a rainstorm without allowing leachate to get to the town.

Explanation

After groups come up with their initial design and budget, they will present it to one of the teachers to “sign off” on their plan. Then groups gather their materials from the “supply shop.” Students then construct the base liner for their model landfills. The goal is to keep leachate from getting out of the landfill. Therefore, materials such as clay and geosynthetics are good choices, because water cannot flow through them easily. Students will be reminded to save some funds to purchase materials to build their top cap to put on after the garbage is inserted. After the liner and layers are built, students will fill the landfill with “garbage” making sure not to let the leachate seep out into the area around the landfill. Students will record the quantity of garbage (cotton balls soaked in food coloring) that their landfills can hold on the worksheet. Students will have time to finish constructing the top cap liner systems for their landfills. The purpose of the top cap is to keep the rain out of the landfill. Therefore, like the bottom liner system, it should be made of materials water cannot flow through. Additionally, some protection (such as gravel) can be placed on top to keep rainwater and sunlight from eroding away the liner.

Assessment

Pre-Activity Assessment

*Brainstorming*: We will engage the students in open discussion as a class and will remind them that no idea or suggestion is "silly." All ideas will be respectfully heard. We will ask the students:

* What can we do with garbage that does not get recycled or composted? (Answer: Put it in landfills.)
* How might we decrease the amount of trash that gets put in landfills? (Possible answers: Do a better job recycling, use less packaging, reuse more things, do more composting, burn our waste, use fewer things [buy fewer clothes, toys, products, etc.].)
* What materials do we want to use to use to keep garbage "juice" (leachate) from flowing out of our landfills? (Possible answers: Impermeable materials, low-permeability materials, clay.)

Activity Embedded Assessment

*Activity Worksheets*: We will have student teams complete the [Roles and Optimization Worksheet](https://www.teachengineering.org/collection/cub_/activities/cub_enveng/cub_enveng_lesson05_activity2_rolesopsworksheet_v2_dwc.pdf) and [Budget Worksheet](https://www.teachengineering.org/collection/cub_/activities/cub_enveng/cub_enveng_lesson05_activity2_budgetworksheet_v2_dwc.pdf). We will gauge their understanding of the subject matter by observing their use of the worksheets.

*Design Presentations*: We will have groups present descriptions of the model landfills they designed and created, addressing the following questions:

* Did your landfill keep the town safe? Why or why not?
* What was the most effective part of your design?
* What was the least effective part of your design?
* How did the different materials perform?

Post-Activity Assessment

*Optimization Discussion*: We will lead a class discussion asking students the following questions:

* What does optimization mean? (Answer: For any given engineering challenge, many possible design solutions exist. In engineering, optimization means finding the best solution, which is usually a compromise among several often conflicting requirements [such as cost, capacity, performance, etc.].)
* Which group had the most optimal design (most garbage, least cost and best performance)?
* What were some characteristics of good vs. bad designs?

Self-Evaluation

Students will self-assess themselves on a scale of one to four (one being the weakest and four being the strongest) on their ability to work cooperatively with their peers.

Special Needs

For the two ELL students in the class, we will ensure that directions are on the document camera, visuals are used in our examples and slides, and that repeated clarification on content is provided on a one-on-one basis.  We will provide a guide sheet that has a visual guide to how a landfill works and with the academic vocabulary in age-appropriate language.

Technology

We will use the document camera to show images and read aloud segments of text using PowerPoint. We will also ask students to read aloud pieces of text on the PowerPoint.

Materials

For each group (6 total):

* clear plastic tub (~12-in long × 6-in wide × 5-in deep) (~30-cm x 15-cm x 13-cm) with about 1 inch (2.54 cm) of sand in the bottom
* clay (~750 cm3), this clay does not need to be the high-quality type used for modeling; clayey or silty soil from your backyard works fine
* sand (~1500 cm3) (available at home and garden stores)
* gravel (~100 cm3) (available at home and garden stores)
* ~15 cotton balls
* (optional) tiny houses and buildings (such as Monopoly game houses and hotels), or any other simple representation to simulate the presence of a town sitting on the sand base
* [Roles and Optimization Worksheet](https://www.teachengineering.org/collection/cub_/activities/cub_enveng/cub_enveng_lesson05_activity2_rolesopsworksheet_v2_dwc.pdf)
* [Budget Worksheet](https://www.teachengineering.org/collection/cub_/activities/cub_enveng/cub_enveng_lesson05_activity2_budgetworksheet_v2_dwc.pdf)

For the entire class to share:

* food coloring
* clear plastic tub in which to mix together food coloring, water and cotton balls ("garbage")
* (optional) gloves or spoon to "mix" the garbage
* strips of plastic garbage bags, to simulate geosynthetics used in landfills
* toothpicks
* straws
* popsicle sticks
* small, paper "Dixie" cups (~85 ml size), to measure and distribute clay, gravel and sand
* access to water
* watering can, water bottle or other "rain storm" device
* (optional) electric fan, to simulate the erosion force of wind

**Taking Action Project**

Learning Target

Students will synthesize their learning and design an action project that works to improve one component of our waste management system.

Timing

10 minute introduction to project, 30 minutes work time, 10 minutes presentations and conclusions

Invitation

We will share photos of creative solutions to our issues with waste management, such as a 19-year old’s invention to remove trash from the Great Pacific Garbage Patch and art projects made out of trash that help to raise awareness about garbage and promote recycling.  We will have a discussion about how some ideas can help us prevent garbage from entering the waste stream, and others help us safely deal with the waste we must throw away.

Exploration

Students will have two minutes to decide whether to work independently or with classmates on the Taking Action Project.  We will then distribute a handout that provides a range of potential Taking Action project ideas, such as trash art, increased presence of recycling and compost receptacles in cities, fines for not recycling, or a sieve to clear plastics out of the ocean.  The list is provided to show students the wide range of possibilities for their action project and students will either be able to select one of the ideas from the list or come up with their own.

Explanation

We will explain the parameters for the Taking Action Project to the students.  It must work to solve a problem with our waste system, whether it be raising awareness, a new idea for waste management technology, or a product or design that makes it easier for people to recycle or reuse products.  Students will select from a menu of forms of expression for their Taking Action Project.  They can either write a persuasive letter to a pertinent audience, do a creative art project, illustrate an engineering design, or use their laptops to create a comic or a padlet.

Assessment

Taking Action Projects will be evaluated on how well they incorporated their learning from the day and took action to try and solve a problem with our waste system.

Special Needs

Directions for the project will be given both orally and in writing on the handout so as to provide support for the two ELL students in the class.  We will check in with these two students during their research and their development of their project to determine if additional language supports will be needed.

Technology

Students will use their laptops to research their topic and to create comics or padlets to express their Taking Action Project.

References

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Appendices

**Cooperative Learning Self-Assessment**

Name: Date:

On a scale of 1-4, 4 being the most successful, please rate how successfully you performed on the following:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Social Skills Behaviors** | **1** | **2** | **3** | **4** |
| **Contributions to the group:**  I provided useful ideas to the group to accomplish a task. |  |  |  |  |
| **Problem Solving:**  I suggested solutions to problems both in how to work effectively as a group and to accomplish the task. |  |  |  |  |
| **Task focus:**  I stayed focused on the task and did my fair share of the work. |  |  |  |  |
| **Working with others:**  I listened to other’s ideas. I was willing to compromise to accomplish the task. |  |  |  |  |
| **Attitude:**  I was positive and encouraged others in the group. |  |  |  |  |

Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Date:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Morning Math Warm-up

1. Estimate how many pounds of trash you create in one day.

1. Use your estimate from #1 to calculate how many pounds of trash you create in one year. (1 year = 365 days)

1. There are 54,790 people who live in Shoreline.  Use your answer from question #2 (rounded to the nearest whole number) to calculate how many total pounds of trash are created by the residents of Shoreline in one year.